SECRET

UNIQUE DOCUMENT # SAC200086910000

LA-11404

This document consists of 30 pages.

Number 31 of 122 copies, Series A.

Nuclear Weapon Data
Sigma 1

Critical Nuclear Weapon
Design Information
DoD Directive 5210.2 Applies

A Brief History of the First Efforts of the Livermore Small-Weapons Program (U)

Lawrence S. Germain

January 2, 1991

RESTRICTED DATA
This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Unauthorized disclosure subject to administrative and criminal sanctions.

Derivative Classifier
E. M. Sandoval
OS-6 Classification Analyst

CNSS
Center for National Security Studies
Los Alamos National Laboratory

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

SECRET

CENTER FOR NATIONAL SECURITY STUDIES

The Center for National Security Studies is a studies and analysis organization of the Los Alamos National Laboratory. Drawing on the broad knowledge at Los Alamos of science and engineering relevant to national security issues, the Center's research focuses on the interaction between technology and policy and on developing insights that may improve the relationship between the development of new technology and the achievement of national policy goals. The Center's staff includes both resident and visiting researchers.

The Center promotes and conducts long-term research and analysis in the broad areas of defense policy and arms control. In addition, it provides insight into near-term national security policy, strategy, and technology issues in support of Laboratory management and staff. The Center also facilitates the exchange of ideas on international security issues among Laboratory personnel, government agency staffs, university faculties, and interested citizens.

The Center documents its work in a number of publications. The *Briefings* are informal papers commenting on timely topics that are appropriate to the Center's areas of interest. The *Reports* are formal research papers or edited conference proceedings. A book series, ***Issues in International Security***, presents the results of the Center's research on key national and international security issues.

LA-11404

SECRET

January 2, 1991

A Brief History of the First Efforts of the Livermore Small-Weapons Program (U)

Lawrence S. Germain

Nuclear Weapon Data
Sigma 1

Critical Nuclear Weapon
Design Information
DoD Directive 5210.2 Applies

RESTRICTED DATA
This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Unauthorized disclosure subject to administrative and criminal sanctions.

CNSS
Center for National Security Studies
Los Alamos National Laboratory

SECRET

Lawrence S. Germain retired from the Los Alamos National Laboratory in 1985 after thirty years of experience in weapons design and testing in the national laboratories—twenty years at Lawrence Livermore National Laboratory and ten years at Los Alamos. He received a Ph.D. in physics from the University of California, Berkeley, in 1949 and taught physics for four years at Reed College, Portland, Oregon, before joining Livermore. Much of this report is drawn from the author's memory, and many of the opinions expressed reflect his personal recollections.

The first draft of this report was written in 1988, and the information in the report does not reflect events or research since 1988.

CONTENTS

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

PREFACE

This report is one in a CNSS series that surveys the development of nuclear weapons over the past forty-five years. The unifying themes throughout the series are the technical advances and failures associated with new weapon systems, and the creation of the stockpile.

Authors, titles, and report numbers are listed below.

William G. Davey, *Free-Fall Nuclear Bombs in the U.S. Stockpile (U)*, LA-11397

William G. Davey, *Nuclear Tests Related to Stockpiled Weapons Development (U)*, LA-11402

Lawrence S. Germain, *A Brief History of the First Efforts of the Livermore Small-Weapons Program (U)*, LA-11404

Lawrence S. Germain, *The Evolution of U.S. Nuclear Weapons Design: Trinity to King (U)*, LA-11403

Lawrence S. Germain, *A Review of the Development of Los Alamos Gnats and Tsetses before the 1958 Test Moratorium(U)*, LA-11749

Raymond Pollock, *The Evolution of the Early Thermonuclear Stockpile (U)*, LA-11748

Raymond Pollock, *A Short History of the U.S. Nuclear Stockpile 1945–1985 (U)*, LA-11401

(All reports are classified Secret Restricted Data)

A BRIEF HISTORY OF THE FIRST EFFORTS OF THE LIVERMORE SMALL-WEAPONS PROGRAM (U)

Lawrence S. Germain

ABSTRACT (U)

This report, one in a series concerned with the history of nuclear-weapon research and development, describes the evolution of the design of fissile nuclear explosives at the Lawrence Livermore National Laboratory from its inception in 1952 to the nuclear testing moratorium in 1958. Nuclear tests are used as the unifying thread for the description of this evolution. The most important families of nuclear devices are identified, their evolution is outlined, and the stockpile weapons that resulted are indicated.

INTRODUCTION

Using the nuclear test program as a framework, this report describes the evolution of the design of fission explosive systems at the Livermore Laboratory up to the 1958 nuclear test moratorium. To understand this evolution one must understand the goals and limitations of the Livermore program. What were they trying to do?

Before 1952, all U.S. nuclear-weapons design was centered at Los Alamos (then the Los Alamos Scientific Laboratory; now the Los Alamos National Laboratory). The establishment of nuclear-weapons design activities at Livermore (then the University of California Radiation Laboratory; now the Lawrence Livermore National Laboratory) in 1952 offered the first opportunity for interlaboratory competition in this area. The Livermore fission-weapons program in those years was based on the assumption that it was not to duplicate active Los Alamos programs. [redacted] The official status of such a restriction is unclear, but it was the basis of operation at Livermore. At the same

[redacted]

DOE b(3)

They all worked—some better than others—but several were of limited or no practical use.

It did serve, however, as a learning experience for the Livermore Small-Weapons Group—mostly green Ph.D.s who were complete novices at weapons design. They developed and used two-dimensional calculations, gained experience with the properties and fabrication of high explosives and fissile materials, and gained experience in nuclear field-test operations.

The story to be told is complex. In Part I, Livermore tests are described in chronological order because this gives the best indication of the development. This sequence can be confusing; thus, to assist the reader, the tests are described in Part II in terms of families that link together in a coherent way.

PART I: CHRONOLOGICAL DESCRIPTION

Teapot

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

The feeling in Livermore was do or die. These tests *had* to be successful—or else! The first one up was Tesla and the results were considered successful. It was followed by Turk one week later (March 7, 1955). With a yield of 44 kt, Turk was also considered a success—as was Post.

The low point of the weapons design history of Livermore had been passed—but not without considerable turmoil. Shortly before the date of the Tesla test, news reached Livermore concerning the results of some experiments on the equation of state of plutonium that had been carried out at Los Alamos.

Tesla was not threatened with failure—quite the opposite—but much of the diagnostic equipment was set for the wrong levels. In a great flurry of activity, the expected yields of Post and Tesla were recalculated. There was some bitterness in Livermore towards Los Alamos because it was felt that these important data could have been made available at an earlier date. The Los Alamos rejoinder was that they did not wish to make data available until they were certain of the results and were certain that the results would not be misused. This whole exchange was indicative of an unhealthy tension at that time between the two laboratories.

Redwing

Operation Teapot had, by and large, been an important step in Livermore's growth. At the start, the Livermore weapons designers felt they had their backs to the wall.

DOE b(3)

DOE b(3)

The Livermore Small-Weapons Program thus organized a three-prong attack for operation Redwing.

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

Plumbbob

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

[redacted]

The design physicist was repeatedly scolded for presenting unpromising results. He was urged to make the system work. As a result, he took the most optimistic view of each of the several areas of uncertainty in the design—too optimistic, as it turned out. It was only the nuclear test that revealed the overly optimistic approach. In the absence of nuclear testing, the design errors might never have been uncovered. [redacted] If there were no tests to keep the system honest, nuclear designers could be pressured into certifying designs that would not work. [redacted]

There were other Livermore tests in Operation Plumbbob to which the Livermore Small-Weapons Group did not contribute. [redacted]

[redacted] Rainier was detonated on September 19, 1957, in a tunnel in Area 12. Rainier also gave its name to the mesa into which the tunnels were dug (Rainier Mesa) and to the volcanic rocks that cap that mesa (Rainier Mesa Tuff).

58A

As more and more weapons entered stockpile and came into the hands of people less knowledgeable about nuclear design, questions about the safety of nuclear weapons assumed more importance. One of the first questions to receive serious attention was one-point safety. The requirement was that no more than four pounds of nuclear yield should be produced as a result of the detonation at *any* one point in the HE, perhaps because four pounds is small compared with the amount of HE in the various devices. [redacted]

As a consequence of these concerns, a series of one-point tests was conducted at the NTS called Operation 58A, which included two safety tests, Venus and Uranus, of Livermore devices. These were carried out between Operation Plumbbob and Operation Hardtack. [redacted]

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

Quince and Fig were fired on Runit (Yvonne) Island in Eniwetok Atoll as close to the ground as pos-

DOE b(3)

sible—the standoff of a few inches being required by the device designers to ensure that the presence of the ground did not perturb the implosion. This near-ground test was required to accommodate a fallout experiment conducted by Sandia. [redacted]

DOE b(3)

[redacted]

DOE b(3) DOE b(3)

There being no other NTS soil at hand, the Fig device was emplaced in the same location—radiation field or no. The Hamilton test was fired at the top of a 50-ft wood tower in Frenchman Flat, and Humboldt was fired atop a hastily constructed 25-ft wood tower in Area 3 of the NTS.

[redacted]

DOE b(3)

Laboratory interest in small, clean, and relatively clean warheads led to the testing of several unique systems. [redacted]

DOE b(3)

DOE b(3)

[redacted]

PART II: FAMILIES

In these figures, arrows indicate the progression from one test to another. Many of these arrows are labeled with a number, and a brief description of the change indicated by that particular arrow is given.

AFAP

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

DOE b(3)

[redacted]

Strike 3—and the most important strike. The two laboratories decided to assign the project to Los Alamos. In those early days, there was a rather civilized process known as the pie split. Every year the two laboratory directors and their staffs would meet to decide which tasks would be undertaken by each of the laboratories. The Livermore management always returned from these meetings in exultation, feeling that they had not just taken most of the pie but also the crumbs on the table. However, as time went on the Los Alamos projects remained rock solid while the Livermore projects seemed to fall away, possibly because Los Alamos was taking the mainline projects and Livermore was taking the far out ones. In due time, the pie split went away. The laboratory directors found it increasingly difficult to reach accord, and the Washington bureaucrats could not countenance such important decisions being made in the field. [redacted] This writer was not present at the meeting and has heard two quite different stories about what happened.

[redacted] Bradbury said he was not interested. Several of his staff said they were interested. After a caucus, they agreed to the trade.

Story No. 2 is logical. Livermore badly wanted responsibility for a high-yield strategic warhead of their design. Only by having both the primary and secondary of a major strategic warhead identified as "designed in Livermore" could the Livermore Laboratory gain the status of a full partner in the nuclear-weapons design world. In fact, in subsequent years, Livermore made a special effort to gain responsibility for strategic nuclear weapons. [redacted]

DOE
b(3)

DOE
b(3)

DOE
b(3)

DOE
b(3)

DOE
b(3)

DOE
b(3)

LA-11404 DISTRIBUTION

Address	Copy No.
U.S. Department of Energy	
Library, MA-442, Room G-042 (GTN) (3 copies)	1A–3A
Attn: Transfer Accountability Station	
Washington, DC 20545	
For: Department of Energy Washington, Washington, DC	4A
Assistant Secretary for Defense Programs, DP-1, 4A-014/FORS	5A
Deputy Assistant Secretary for Military Application, DP-20, A-367/GTN	6A
Director, Office of Weapons Research, Development, and Testing, DP-24, A-368/GTN	7A
Director, Weapons Research Division, DP-242, A-386/GTN	8A
Director, Advanced Concepts Division, DP-241, B-314/GTN	9A
Director, Inertial Fusion Division, DP-243, C-417/GTN	10A
Associate Director for Weapons Program Safety, DP-20.1, C-417/GTN	11A
Office of Weapons Safety and Operations, DP-22, C-420/GTN	12A
Office of Weapons Production, DP-23, A-483/GTN	13A
Office of Planning and Project Management, DP-25, A-467/GTN	14A
Deputy Assistant Secretary for Security Affairs, DP-30, 4C-024/FORS	15A
Office of Classification and Technology Policy, DP-32, C-379/GTN	16A
Deputy Assistant Secretary for Security Affairs, DP-30, 4C-024/FORS	17A
Office of Classification and Technology Policy, DP-32, C-379/GTN	18A
Deputy Assistant Secretary for Nuclear Materials, DP-10, 4A-043/FORS	19A
Director, Office of Nuclear Materials Production, DP-13, A-302/GTN	20A
Director, Office of Arms Control, DP-5, 4B-014/FORS	21A
U.S. Department of Energy	22A
Office of Scientific and Technical Information	
P.O. Box 62	
Oak Ridge, TN 37831	
Attn: Weapon Data Index	
U.S. Department of Energy	
Albuquerque Operations Office	
Attn: TA Station (1 copy)	23A
P.O. Box 5400	
Albuquerque, NM 87115	
Sandia National Laboratories	
Attn: Mail Services Section	
P.O. Box 5800	
Albuquerque, NM 87185	
For: Technical Library (2 copies)	24A, 25A
University of California	
Lawrence Livermore National Laboratory	
Attn: Mail Stop L-313	
P.O. Box 808	
Livermore, CA 94550	
For: Library, Reports Section (2 copies)	26A, 27A
John H. Nuckolls, Director	
Director	
Defense Nuclear Agency	
Attn: SSAB (2 copies)	28A, 29A
6801 Telegraph Rd.	
Alexandria, VA 22310-3398	

Address	Copy No.
FCDNA/FCSAC Attn: Bettye J. Garbutt (2 copies) Kirtland AFB, NM 87115-5000	30A, 31A
WL/SUL Kirtland AFB, NM 87117-6008	32A
Los Alamos National Laboratory Attn: Report Library (2 copies) Mail Station 5000 P.O. Box 1663 Los Alamos, NM 87545	33A, 34A
For: S. S. Hecker, DIR, MS A150	35A
T. P. Seitz, NWT-WP, MS F633	36A
J. F. Jackson, DIR OFC, MS A101	37A
J. C. Browne, ADDRA, MS A110	38A
J. C. Hopkins, ADAL-CNSS, MS A112	39A
F. A. Morse, ADR, MS A114	40A
E. M. Wewerka, ADCM, MS A102	41A
J. T. Whetten, ADET, MS A107	42A
C. A. Fenstermacher, NWT/AGEX, MS P916	43A
D. C. Cartwright, NWT/ICF, MS E527	44A
J. C. Porter, X-DO, MS B218	45A
D. W. Watkins, NWT/PD, MS B218	46A
P. T. Cunningham, CM/NM, MS F628	47A
L. W. Madsen, ADNWT, MS F633	48A
R. E. Kelley, ADNWT, MS F633	49A
Turner J. Trapp, A-DO, MS F606	50A
Richard J. Beckman, A-1, MS F600	51A
J. Wiley Davidson, A-3, MS F607	52A
Richard Mah, CM/WCR, MS G753	53A
Stanley O. Schriber, AT-DO, MS H818	54A
Dennis H. Gill, CLS-DO, MS J563	55A
Harry J. Dewey, CLS-1, MS G740	56A
Harry H. Watanabe, CLS-3, MS J563	57A
Patrick Garrity, CNSS, MS A112	58A–61A
Roger A. Meade, CRM-1, MS C322	62A
Rulon K. Linford, CTR-DO, MS E529	63A
John D. Immele, DRA-CDT, MS F668	64A
Sidney Singer, DRA-DEST, MS F617	65A
C. L. Edwards, EES-3, MS C335	66A
W. Doyle Evans, ET-AC, MS F650	67A
Robert A. Jeffries, ET-AC, MS F650	68A
Charles F. Keller, ET-IGPP, MS D437	69A
Robert R. Ryan, INC-4, MS C346	70A
William R. Daniels, INC-11, MS J514	71A
Danny B. Stillman, IT-DO, MS B224	72A
Delbert M. Jones, IT-2, MS B229	73A
Arvid S. Lundy, IT-3, MS B230	74A
Harald O. Dogliani, IT-4, MS B232	75A
Joel N. Peterson, J-6, MS C925	76A
Jerry N. Beatty, J-7, MS D411	77A

Address	Copy No.
D. J. Erickson, ADNWT, MS A105	78A
Thomas E. Larson, M-1, MS C920	79A
J. Michael Christian, M-4, MS P940	80A
Charles E. Morris, M-6, MS J970	81A
John M. McAfee, M-7, MS P950	82A
James W. Straight, M-8, MS J960	83A
Allan B. Anderson, M-9, MS P952	84A
John D. Allen, MEE-4, MS G787	85A
Peter L. Bussolini, ENG-3, MS A150	86A
Donald J. Sandstrom, MST-DO, MS G756	87A
James L. Anderson, MST-3, MS C348	88A
George F. Hurley, MST-4, MS G771	89A
Hugh Casey, ADCM, MS A102	90A
Thomas J. Hirons, N-DO, MS E561	91A
Nicholas Nicholson, N-2, MS J562	92A
Delbert R. Harbur, NMT-DO, MS E500	93A
Robert Bruce Matthews, NMT-1, MS E505	94A
Robert H. Day, P-DO, MS D408	95A
Gottfried T. Schappert, P-DO, MS E545	96A
Thomas F. Stratton, P-DO, MS D408	97A
R. James Trainor, P-1, MS E545	98A
John D. Moses, P-3, MS D437	99A
Larry J. Rowton, P-9, MS D437	100A
D. D. Cobb, SST-DO, MS D437	101A
James N. Johnson, T-1, MS B221	102A
Phillip G. Young, T-2, MS B243	103A
John W. Hopson, T-3, MS B216	104A
James P. Ritchie, T-14, MS B214	105A
G. G. Hill, WX-DO, MS P945	106A
Joseph Lynn Parkinson, WX-3, MS C930	107A
Charles B. Banks, WX-5, MS G780	108A
John J. Ruminer, WX-11, MS C931	109A
H. P. Newton, X-4, MS F664	110A
P. C. White, X-DO, B218	111A
Donald C. Wolkerstorfer, X-DO, MS B218	112A
Douglas C. Wilson, X-1, MS F645	113A
Rodney B. Schultz, X-2, MS B220	114A
Richard A. Krajcik, X-4, MS F664	115A
David A. Poling, X-5, MS F669	116A
Robert C. Little, X-6, MS B226	117A
Eldon J. Linnebur, X-7, MS B257	118A
John H. Brownell, X-10, MS B259	119A
Office of the Assistant to the Secretary of Defense (Atomic Energy) Room 3E1074, The Pentagon Washington, DC 20301-3050 For: Deputy Undersecretary of Defense Research and Engineering (Atomic Energy)	120A
Defense Intelligence Agency Attn: DT-1B Branch Chief Washington, DC 20340-6160 For: Charles E. Rowe, LTCOL/USAF	121A
Chief Joint Atomic Information Exchange Group 6801 Telegraph Rd Alexandria, VA 22310-3398	122A

~~SECRET~~